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Tricholomopsis in Europe — phylogeny, key, and notes on variability

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Abstract— *Tricholomopsis* (*Basidiomycota*, *Agaricales*) species in Europe were studied by classical and molecular methods (morphology, anatomy; sequences of nuclear rDNA containing ITS1, ITS2, 5.8S and part of 28S regions). The identity of four species was confirmed: *T. rutilans*, *T. flammula*, *T. decora*, *T. osiliensis*. Within *T. flammula*, two well-supported groups were recovered. An identification key based on a better understanding of the species limits was prepared. All species are briefly characterized and their variability is discussed. *Tricholomopsis ornata* should be rejected; it is considered a doubtful, poorly documented taxon, and the name has been variously interpreted.

Key words— *Fungi*, macromycetes, taxonomy, nomenclature

Introduction

The genus *Tricholomopsis* Singer is represented in Europe by a rather small number of species. Most authors recognise only the well-known species *T. rutilans* and *T. decora* (e.g., Boekhout & Noordeloos 1999, Gröger 2006, Vesterholt 2008). Some identification keys give two more species, namely *T. flammula* and *T. ornata* (Moser 1983, Bon 1995, Horak 2005). The identity of *T. flammula* was documented recently using both classical and molecular methods (Holec 2009, Holec & Kolařík 2011). In 2009, the new species *T. osiliensis* was described by Vauras (2009) from the Estonian island Saaremaa (Osilia in Latin). Four species (*T. rutilans*, *T. ornata*, *T. flammula*, *T. osiliensis*) are reported from Estonia (Kalamees 2011). Altogether, five species have been reported from Europe. However, *T. ornata* is poorly documented as there are no well-described records agreeing with the original description by Fries (1838) and a detailed DNA study comparing the species is absent.

In the molecular phylogenetical study by Moncalvo & al. (2002) *Tricholomopsis,* represented by the nuclear LSU rDNA sequence of *T. rutilans,*

was placed in one phylogenetic clade together with *Clavaria fusiformis* and *Marasmius rhyssophyllus*. In a multigene dataset (RPB1, RPB2, ncRNA) another representative species, *T. decora*, fell into a pluteoid clade, outside of any conventional families, close to *Amanitaceae* (Matheny & al. 2006). To date, a detailed DNA study has been published only on *T. flammula* (Holec & Kolařík 2011).

The aim of this study is to verify the identity of *Tricholomopsis* species in Europe by classical and molecular methods and to prepare an identification key based on a better understanding of species limits.

Material & methods

Morphological study

Fresh and dried collections of *Tricholomopsis* species from Europe were studied. Voucher specimens are kept in herbaria PRM, WU, TU, and TUR-A (formerly TURA). For herbarium acronyms see Thiers (2012). All collections were studied by traditional taxonomic methods (generally: Singer 1986, Bas & al. 1988; specifications: Holec 2009). Spore sizes are presented as the main data range (c. 10–90 percentile values), flanked by extreme values in parentheses, of all spores measured (20 measurements per collection). The spores were measured directly in the microscope using the eyepiece micrometer with the basic scale division of 0.8 µm and distinguishable difference of 0.4 µm. Thus, the scale reading was made in the following steps (in µm): 1.6, 2.0, 2.4, etc.

DNA study

Genomic DNA from nine herbarium specimens (Tab. 1) was isolated using ArchivePure DNA Yeast and Gram-+ Kit (5 PRIME, Inc. Gaithersburg, MD) with modified time of the incubation with Lytic Enzyme Solution (2h, 37 °C) and Cell Lysis Solution (4h, 64 °C). Nuclear rDNA containing internal transcribed spacers (ITS1 and ITS2), 5.8S and part of 28S regions was amplified with primer set ITS1/LR6 (Gardes & Bruns 1993; Vilgalys & Hester 1990). The reaction mixtures and amplification protocols for rDNA regions were made according to Hulcr & al. (2007) except of polymerase, PerfectTaq Plus DNA Polymerase (5 PRIME, Inc. Gaithersburg, MD) which was used here to overcome amplifications problems. Custom purification of PCR products and sequencing was done at Macrogen Inc. (Seoul, South Korea) using the primers ITS1, ITS4S, LR6, NL1 and NL4 (Gardes & Bruns 1993; O'Donnell 1993). Sequences were combined with the most related published *Tricholomopsis* rDNA (Tab. 1) sequences from well documented specimens and aligned in MAFFT v6.861b using Q-INS-i strategy considering secondary structure of rRNA (Katoh & Toh 2008). To filter both gaps and hyper variable regions, we used Gblocks version 0.91b (Talavera & Castresana 2007) with less stringent selection allowing smaller final blocks and gap positions within the final blocks. There were a total of 19 sequences and 1119 positions in the final dataset (unpruned dataset contained 1786 positions) from which 843 were conservative and 274 variable. Maximum likelihood (ML) and Minimum Evolution (ME) analyses were conducted with 1000 bootstrap replicates and default parameters in MEGA 5.0 (Tamura & al. 2011). In both analyses, all positions with less than 5% site coverage were eliminated.

Table 1. *Tricholomopsis* collections used for DNA analysis.

Species	Country	Locality	Reference	GenBank	Voucher
T. flammula	Czech Rep.	Boubínský prales	Holec (2009), Holec & Kolařík (2011)	FN554893	PRM 899108 (JH 149/2008)
	Czech Rep.	Čerňava	Holec & Kolařík (2011)	FN554894	PRM 899459 (JH 227/2008)
	Czech Rep.	Na Stříbrné	Holec & Kolařík (2011)	FN554896	PRM 909608
	Slovakia	Badínsky prales	This study	HE649939	PRM 899162 (JH 140/2009)
	Slovakia	Dobročský prales	This study	HE649940	PRM 899180 (JH 162/2009)
	Slovakia	Dobročský prales	This study	HE649941	PRM 899190 (JH 172/2009)
	Austria	Eichberg	Holec & Kolařík (2011)	FN554897	WU 12087
	Austria	Rote Au	Holec (2009)	FN554892	WU 25091
	Austria	Dürradmer	This study	HE652866	WU 13075
	Pakistan	Diamir, Fairy Meadows	Razaq & Khalid (unpublished)	FR822742	SR 161
T. decora	Czech Rep.	Olšinka	Holec & Kolařík (2011)	FN554890	PRM 882317
	Czech Rep.	Malá Niva	Holec & Kolařík (2011)	FN554891	PRM 898238 (JH 218/1997)
	Slovakia	Badínsky prales	This study	HE649942	PRM 899160 (JH 145/2009)
	USA	Massachusetts, Harvard Forest	Petersen & Hughes (2012)	DQ404384	TENN 62342 (PBM 2482)
T. osiliensis	Estonia	Saaremaa	Vauras (2009), this study	HE649943	PRM 899461 (isotype)
	Estonia	Vormsi	This study	HE649944	TU 101571
	Slovakia	Dobročský prales	This study	HE649945	PRM 899184 (JH 166/2009)
T. rutilans	Czech Rep.	Mt. Kamenná	Holec (2009)	FN554895	PRM 889120 (JH 362/1996)
	Czech Rep.	Kamenný vrch hill	This study	HE649946	PRM 899460 (JH 91/2009)
	Canada	BC, Capilano River	Johnston (2006)	EF530929	UBC F16251

Bayesian searches (MB) were conducted with MrBayes 3.0 (Ronquist & Huelsenbeck 2003) and 1.5 million replicates estimated together with burn-in value in Tracer v1.5 (Rambaut & Drummond 2007). *Pluteus romellii,* known as related to the *Tricholomopsis* group (Matheny & al. 2006), was chosen as outgroup. Sequences obtained in this study were submitted to GenBank (Tab. 1).

Abbreviations

bp: base pairs, JH: Jan Holec, Q: quotient of length/width of the spores, MB: Bayesian analyses using MrBayes, ME: Minimum Evolution analysis, ML: Maximum Likelihood analysis, Qav: mean value of Q in each of the collections studied.

Results and discussion

DNA study

The phylogenetic analysis computed by all three methods consistently recovered five major supported clades (Fig. 1). ME showed the highest statistical supports from all methods. The first clade consists of *T. decora* sequences, where specimen PRM 899160 (1521 bp) showed one base pair difference from two other European specimens and nine base pairs difference from the USA specimen. The next two clades consist of *T. flammula* specimens. The major clade is divided further into two moderately supported subgroups differing in four positions from 1521 bp. Specimen PRM 899190 differs in seven positions in the ITS regions and eleven in the LSU region from the specimen PRM 899108, which represents the second clade. Sequences from *T. rutilans* specimens formed a clade with material from Canada exhibiting ten different positions in the ITS region and six positions in the LSU region. The last clade consists of the little variable group of *T. osiliensis* specimens.

Phylogenetic analysis recovered lineages corresponding with our morphological observations and showing *T. decora*, *T. flammula*, *T. osiliensis* and *T. rutilans* as well defined taxa. Two of the studied species (*T. decora* and *T. rutilans*), known also in North America, showed the presence of vicariant populations resulting evidently from the running allopatric speciation. Our DNA analysis also revealed two well-supported groups ("species") within *T. flammula*. Delimitation of species based solely on molecular data of a single locus, especially in closely related taxa, is tricky. Additional distinguishing characters obtained from more collections could elucidate whether the specimen PRM 899108, previously shown as morphologically different from other *T. flammula* collections (Holec & Kolařík 2011), really represents a separate species.

Key to critically revised *Tricholomopsis* species in Europe

1a. Fibrils or scales on pileus surface red to violet 2

1b. Fibrils or scales on pileus surface without red to violet colour 3

2a. Spores broadly ellipsoid to subglobose, Q = 1.14–1.55, Qav = 1.30–1.35, width 4.0–6.5 µm; mature basidiocarps large and fleshy, stipe always covered with red-violet fibrils to scales . . . . . ***T. rutilans***

2b. Spores ellipsoid, Q = 1.33–2.11(–2.44), Qav = 1.50–1.90, width 3.2–4.8 µm; mature basidiocarps slender, mostly (not usually) small to medium-sized, stipe mostly yellow, rarely covered with red-violet fibrils . . . . . ***T. flammula***

3a. Pileus covered with yellow-green, bronze, olive-brown to olive-black, distinctly upraised scales on brightly yellow to orange ground . . . . . ***T. decora***

3b. Pileus covered with yellow-ochre to orange-brown, fine to coarse, adpressed fibrils or fine scales on less bright, yellow to ochre ground . . . . . ***T. osiliensis***

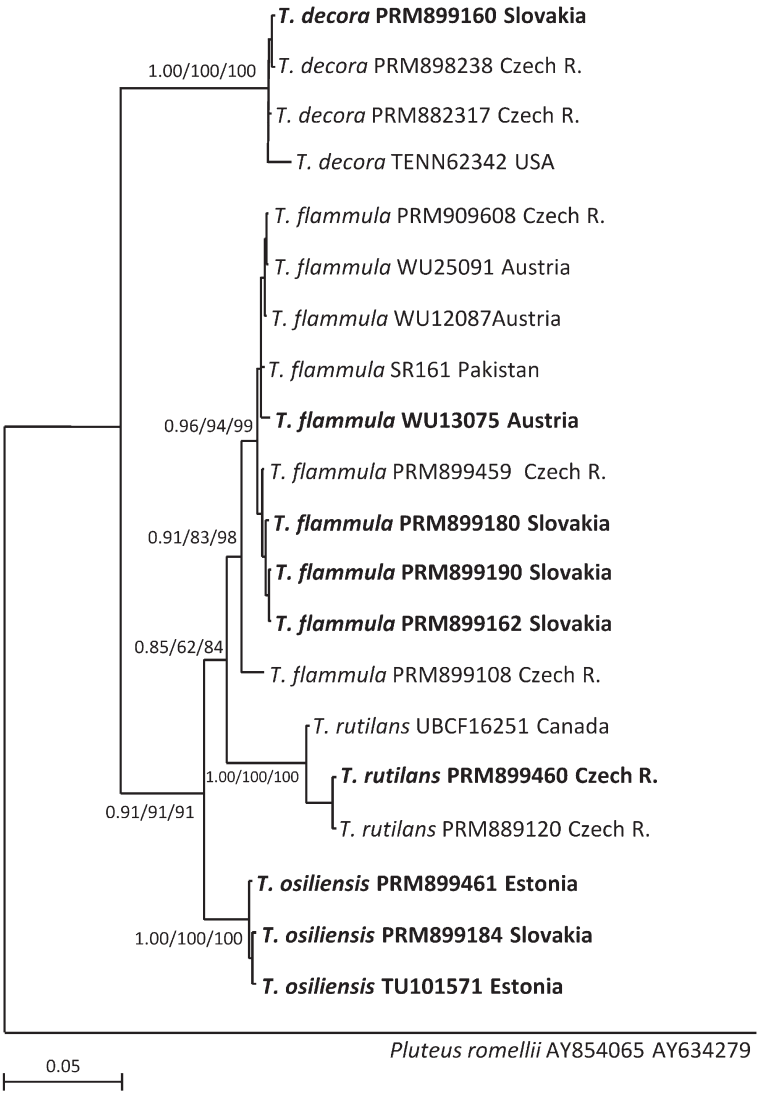

Figure 1. ITS-LSU rDNA based phylogram obtained from Bayesian inference depicting relationships among European *Tricholomopsis* species. The numbers from left to right refer to posterior probabilities of the Bayesian Markov chain Monte Carlo analysis, percentage bootstrap values of Maximum Likelihood and Minimum Evolution analysis. Values smaller than 50% are not shown. Branch lengths are scaled in terms of expected numbers of nucleotide substitutions per site. Sequences printed in bold were obtained during this study.

Survey of critically revised *Tricholomopsis* species in Europe

Tricholomopsis rutilans (Schaeff. : Fr.) Singer 1939

Selected descriptions and icones. Breitenbach & Kränzlin (1991: no. 445), Ryman & Holmåsen (1992: 281), Boekhout & Noordeloos (1999: 151–152), Ludwig (2000: no. 85.3.B, C; 2001: 680), Roux (2006: 380), Vesterholt (2008: 334–335).

Diagnostic characters — Basidiocarps large and fleshy when mature, pileus and stipe densely covered with red-violet fibrils to scales. Spores broadly ellipsoid to subglobose, rarely broadly obovoid or ellipsoid, 5.0–8.5 × 4.0–6.5 µm, Q = 1.14–1.55, Qav = 1.30–1.35; pleurocystidia absent or rare.

Distribution and ecology — Common throughout Europe; living on dead wood of conifers, often buried in soil; in all forest types, in clearings, along forest roads, in parks and gardens.

Comments — *Tricholomopsis rutilans* is easily recognizable by the large and fleshy basidiocarps (when mature), red-violet fibrils or scales on pileus and stipe surface, and above all by the broadly ellipsoid to subglobose spores. A typical *T. flammula* mostly differs by slender basidiocarps with yellow stipes and more elongated (ellipsoid), more slender spores. However, in some cases its basidiocarps reach almost the same size as those of *T. rutilans* and the stipe is covered by violet fibrils, especially when young. In such cases, the spore shape and size (see the key above) and abundance of pleurocystidia are decisive for correct identification of *T. flammula*.

Collections studied — **CZECH REPUBLIC**. Krkonoše Mts., Rokytnice n. Jizerou: Dvoračky, decayed trunk of *Picea abies*, 13.X.1946 leg. J. Kubička (PRM 520341). Central Bohemia, Dobřichovice, on bark of *Picea abies*, 15.X.1996 leg. M. Svrček (PRM 889808). Šumava Mts., Mt. Kamenná, on soil under *Picea*, 28.VIII.1996 leg. J. Holec (PRM 889120). Nová Bystřice, stream valley S of Kamenný vrch hill, on stump of *Picea abies*, 17.IX.2009 leg. J. Holec (PRM 899460). **SLOVAKIA**. Západné Tatry Mts., Mt. Osobitá, on decayed trunk of *Picea abies*, 7.IX.1979 leg. R. Leontovyč (PRM 821774). **UKRAINE**. Eastern Carpathians, Dilove ("Trebušany"), Mt. Menchul ("Menčul"), *Abies alba*, VIII.1934 leg. A. Pilát (PRM 497334).

Tricholomopsis flammula Métrod ex Holec 2009

Selected descriptions and icones. Métrod (1946: p. 77, pl. 1: fig. 5), Cetto (1995: fig. 1010), Krisai-Greilhuber & Voglmayr (2000), Holec (2009), Holec & Kolařík (2011).

Diagnostic characters — Basidiocarps slender, not fleshy, small to medium-sized, rarely large (pileus ≤ 11 cm), young pileus densely covered with fine red-violet to purplish brown fibrillose scales which become scarce on mature pileus, stipe mostly pale yellow, lemon-yellow to bright yellow, rarely (especially when young) covered with fine, red-violet to violet-brown fibrils. Spores variable in length, rather elongated, ellipsoid, (5.2–)5.6–8.0(–8.8) × 3.2–4.8 µm, Q = 1.33–2.11(–2.44), Qav = 1.50–1.90, pleurocystidia abundant, with pale yellow refractive content.

Distribution and ecology — Widespread but rare throughout Europe; on dead conifer wood, mostly fallen decaying trunks of *Abies* and *Picea*, rarely on wood of deciduous trees (*Fagus*), in forests, shrubs and abandoned orchards; from the hilly country to the mountains. In the Czech Republic and Slovakia, the species clearly prefers natural to virgin forests; however, records from habitats strongly influenced by man are known, too.

Comments — In most cases, *T. flammula* is a small to medium-sized fungus with a pileus ≤ 5(–8) cm broad. Rarely the pileus can reach a diameter of 11 cm (PRM 899191) but even then the basidiocarp remains slender (less fleshy) than similarly sized *T. rutilans* basidiocarps. In previous publications (Krisai-Greilhuber & Voglmayr 2000, Holec 2009, Holec & Kolařík 2011) a yellow stipe lacking red-violet fibrils or scales is emphasized as one diagnostic character of *T. flammula*. Ample material collected in Slovakia in 2009 (see below) showed that in some collections the young stipe is almost completely covered with a fine violet felt which is present even in older basidiocarps as sparse violet-brown fibrils. Simultaneously, spores were unusually elongated in the Slovak collections, reaching a Qav of 1.72–1.90 in comparison with Qav of 1.51–1.63 in the previously studied collections (Holec & Kolařík 2011). These collections (including PRM 899459 from the Moravian Carpathians), grouped together also in our phylogram (Fig. 1), differ from sister "western and central European clade" in four positions in the entire ITS-LSU region. This group seems to represent a slightly deviating "Carpathian" *T. flammula* subpopulation characterized by larger basidiocarps and more elongated spores (with Q often reaching 2.00–2.44 and Qav = 1.72–1.90). The "western and central European" subpopulation has smaller basidiocarps and less elongated spores (with Q = 1.33–2.00; Qav = 1.51–1.63). In any case, the differences in DNA sequences are negligible and show at most the beginnings of a vicariance.

Consequently, basidiocarp size and stipe surface color are not stable characters and have a limited value for distinguishing *T. flammula* and *T. rutilans*. The reliable distinguishing characters of *T. flammula* are the spore shape and width and the abundance of pleurocystidia (see the key above for details).

Tricholomopsis flammula is a variable species where three infraspecific subdivisions were revealed by molecular methods (i.e. two well-supported groups, one with two moderately supported subgroups, representing the subpopulations discussed above). This fact is phenotypically expressed by variable macrocharacters (see above), a variability previously discussed in Holec & Kolařík (2011) based on a smaller number (5) of molecularly studied collections than here (10). However, the problem remains unresolved. The first clade revealed here is represented by a morphologically variable group of specimens comprising the two subpopulations discussed above and having

both small and medium to large basidiocarps and larger (especially longer) spores [5.6–8.0(–8.8) × 3.2–4.8 µm]. The second clade is represented by only one collection (PRM 899108: Boubínský prales) with rather small, pale basidiocarps (Holec & Kolařík 2011: fig. 4) and small spores [(5.2–)5.5–6.4 × 3.2–4.0 µm]. More collections are needed to understand the limit between the two clades.

Collections studied — See Holec (2009) and Holec & Kolařík (2011) for collections from **CZECH REPUBLIC**, **AUSTRIA** and **FRANCE**.

Additional collections. **SLOVAKIA**. Kremnické vrchy Hills, virgin forest Badínsky prales, fallen decaying trunk of *Abies alba*, 28.IX.2009 leg. J. Lederer (PRM 899162, 899164). Veporské vrchy Mts., virgin forest Dobročský prales, fallen trunk (*Picea*? *Abies*?), 29.IX.2009 leg. S. Komínková (PRM 899180); fallen decaying trunk of *Abies alba*, 30.IX.2009 leg. J. Holec (PRM 899190, 899191).

Tricholomopsis decora (Fr. : Fr.) Singer 1939

Selected descriptions and icones. Breitenbach & Kränzlin (1991: no. 444), Ryman & Holmåsen (1992: 281), Boekhout & Noordeloos (1999: 151–152), Ludwig (2000: no. 85.1; 2001: 678), Roux (2006: 381), Vesterholt (2008: 335).

Diagnostic characters — Basidiocarps medium-sized, ground color yellow to orange, pileus covered with densely arranged, upraised, yellow-green, bronze, olive-brown to olive-black scales. Spores variable in size and shape, broadly ellipsoid to ellipsoid, rarely obovoid or slightly phaseoliform in side view, (6.0–)6.5–9.0(–10) × (4.0–)4.5–6.5(–7.0) µm, Q = 1.20–1.75, Qav = 1.40–1.54, pleurocystidia absent to rare.

Distribution and ecology — Scattered to common throughout Europe; living on dead conifer wood, especially on old stumps and decaying fallen trunks; in moist and shady mixed and coniferous forests, above all in the mountains.

Comments — *Tricholomopsis decora* is a species easily recognized especially from the bright colours and densely arranged upraised scales on pileus surface. For differences from *T. osiliensis* see below.

Collections studied. **CZECH REPUBLIC**. České Švýcarsko national park, site called Babylon, fallen decaying trunk of *Picea abies*, 16.VIII.2011, leg. J. Holec (PRM 899309). Šumava Mts., nature reserve Malá Niva, decaying trunk of *Picea abies*, 6.VIII.1997 leg. J. Holec (PRM 898238). Novohradské hory Mts., virgin forest Žofínský prales, decayed trunk of *Abies alba*, 30.IX.2008 leg. J. Borovička et J. Kubrová (PRM 915260). Hrubý Jeseník Mts., nature reserve Praděd, fallen decaying trunk of *Picea abies*, 25.VIII.2011 leg. J. Holec (PRM 899339). Nízký Jeseník Mts., nature monument Rešovské vodopády, fallen trunk of *Picea abies*, 23.VIII.2011 leg. J. Holec (PRM 899318). **SLOVAKIA**. Kremnické vrchy hills, virgin forest Badínsky prales, fallen decaying trunk of *Abies alba*, 28.IX.2009 leg. J. Holec (PRM 899160). Klenovec, Mt. Klenovský Vepor, decaying trunk of *Abies alba*, 31.VIII.1982 leg. F. Kotlaba (PRM 828487).

Tricholomopsis osiliensis Vauras 2009

Selected descriptions and icones. Vauras (2009).

Diagnostic characters — Basidiocarps medium-sized, yellow, yellow-ochre to brownish yellow, pileus 3.5-9 cm in diam., without distinct upraised scales but with concolorous minute squamules at margin (Vauras 2009) or with coarse, adpressed, ochre-brown fibrils or cords of fibrils (PRM 899184), becoming orange-brown when old. Spores variable in size and shape, broadly ellipsoid, ellipsoid, obovoid, rarely subglobose, 6.0–9.5 × 4.5–6.0 µm, Q = 1.14–1.85, Qav = 1.25–1.54; pleurocystidia present, scarce to frequent.

Distribution and ecology — Apparently a rare species, known from two Estonian islands in the Baltic Sea (Saaremaa: Vauras 2009, Vormsi: TU 101571) and Slovakia (virgin forest Dobročský prales, PRM 899184). The collections originate from fallen decaying trunks of *Picea abies* (Saaremaa, Vormsi) and *Abies alba* (Dobročský prales). It is possible that *T. osiliensis* also occurs in France, as a collection fitting its description was mentioned by Bon (1995) in his remark on *T. decora*.

Comments — The three *T. osiliensis* collections mentioned here form a well-supported clade with little molecular variability. Macro- and microscopically, the Slovak collection clearly differs from the Estonian ones in a pileus covered with coarse fibrils darker (orange-brown) than the ground; the Estonian basidiocarps exhibit almost smooth to finely fibrillose pilei with minute squamules that are present only at the margin. The striking nature of the Slovak fibrils was probably increased by their age and weather conditions (old and partly dried basidiocarps influenced by first autumn frosts). Additionally, spores in the Slovak basidiocarps were distinctly larger (8.0–9.5 × 5.2–6.0 µm) than in the Vormsi (6.0–7.2 × 4.8–5.6 µm) and Saaremaa (6.0–8.2 × 4.5–6.0 µm) collections (see Vauras 2009). However, a rather large spore size variability is typical for all European *Tricholomopsis* species (see above). The spores of *T. osiliensis* have a similarly broad range of spore length values.

Tricholomopsis osiliensis is a recently described, little known species. It is necessary to observe basidiocarp variability in future collections. Based on current data, *T. osiliensis* differs from *T. rutilans* and *T. flammula* by the absence of red-violet fibrils or scales and from *T. decora* by its almost smooth to fibrillose pileus without distinctly upraised scales and less bright pileus cuticle color. It is possible that some collections published as *T. ornata* represent in fact *T. osiliensis* (e.g. Courtecuisse & Duhem 2000: no. 419; see the discussion below).

Collections studied — **ESTONIA**. Island Saaremaa, Salme, Kaugatoma-Lõu, on fallen mossy stem of *Picea abies*, 18.IX.2008 leg. J. Vauras (isotype: PRM 899461). Lääne, island Vormsi, Saxby, rotten trunk of *Picea abies*, 19.IX.2010 leg. I. Saar (TU 101571).

SLOVAKIA. Veporské vrchy Mts., virgin forest Dobročský prales, fallen trunk of *Abies alba*, 29.IX.2009, leg. Š. Malec et P. Žitňan (PRM 899184).

Notes on *Tricholomopsis ornata*

Tricholomopsis ornata (Fr.) Singer is mentioned by some European authors (e.g. Moser 1983, Riva 1988, Bon 1995, Horak 2005). According to the original description by Fries (1838: 130), it is a medium-sized to large, fleshy fungus (pileus 5–12.5 cm broad, stipe about 1.2 cm thick) similar to *T. rutilans* but with a pileus covered with brown flocculose scales ("squamulis flocculosis fulvofuscescentibus"). No red-violet color is mentioned. We do not know any collection corresponding with this description. In the recent book on Scandinavian fungi (Vesterholt 2008), *T. ornata* is not mentioned, although it was originally described from the Uppsala vicinity growing on *Pinus* trunks. In our opinion, *T. ornata* is a doubtful, poorly documented taxon. It is possible that Fries (1838) described abnormal or old *T. rutilans* basidiocarps, which is supported by his note that *T. ornata* is similar to *T. rutilans*.

Bon (1995) is the only recent author describing *T. ornata* in detail and mentioning the material studied. However, his description differs from the original. Bon's fungus is smaller [pileus 3–6 cm, stipe 4–6(–8) × 0.3–0.5 cm] with adpressed, rusty brown to reddish scales on pileus surface and pale lemon-yellow stipe. These characters, including the rather large ellipsoid spores [(6–)7–9(–10) × 4.6–6.0 µm] and the presence of pleurocystidia, suggest that his *T. ornata* could represent *T. osiliensis*. A revision and molecular study of Bon's collections would be desirable to confirm this hypothesis.

Similarly, the illustrations of *T. ornata* by Courtecuisse & Duhem (2000: fig. 419, rather small yellow fungus with adpressed, fibrillose, vividly fulvous brown scales) do not correspond to the original *T. ornata* of Fries but do correspond well with our Slovakian collection of *T. osiliensis.*

Judging from our field experience with *Tricholomopsis* species, the Rebaudengo's illustration of *T. ornata* published in Riva (1988: 61) most probably represents aberrant *T. decora* basidiocarps. The scales agree with the Friesian description (small, floccose, fulvous brown), but the slender stature and bright yellow ground color are more typical of *T. decora*.

There are some recent photographs labeled as *T. ornata*. Those by Domínguez (2008) are closest to the original description by Fries; however, as they are not accompanied by an analysis of microcharacters, their identity remains unclear. On the other hand, the microcharacters presented by Musumeci (2004) clearly show that his *T. ornata* is in fact *T. flammula*.

The discussion shows that different interpretations of the name *T. ornata* exist. It seems that the original *T. ornata* represents aberrant basidiocarps of *T. rutilans,* and since them the name has been erroneously used for collections of *T. osiliensis*, *T. flammula* and *T. decora*. For these reasons we recommend rejecting the name *T. ornata*.

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